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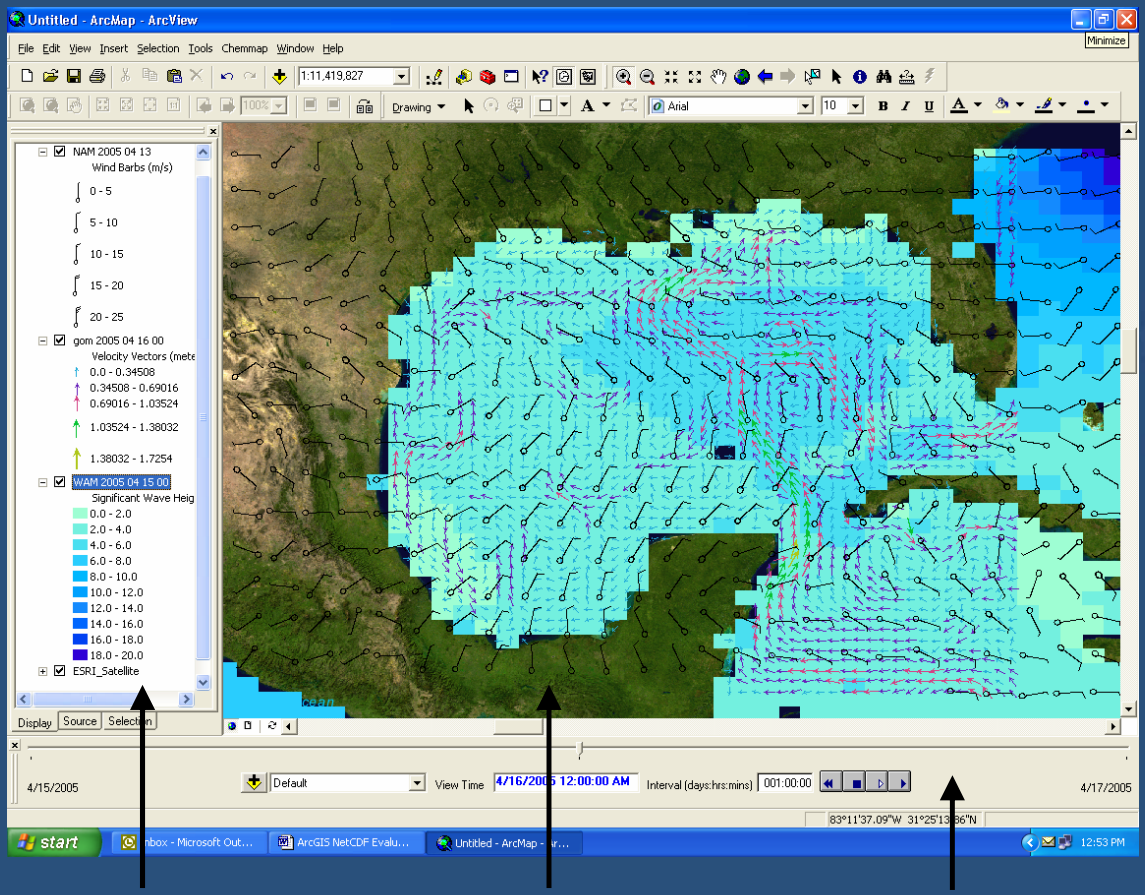
COASTMAP NetCDF/OPeNDAP Layer Extension and TimeSlider Extension Guide



Metocean Custom Layers

Display of vector (surface currents) data

ASA's Time Toolbar Extension

COASTMAP is a framework of components for managing time varying metocean data, both model and observation data and linkage to data analysis tools. COASTMAP also has options to connect the data to response models for oil spills, chemical spills, atmospheric releases, search and rescue as well as general hydrodynamic and water quality models.

The COASTMAP NetCDF/OPeNDAP extension and TimeSlider are built for ArcGIS 9.x and provide the user functions to:

1. Enable NetCDF files to be viewed in their native format in ArcGIS;
2. Open a number of files, visualise and animate scalar and vector data;
3. Time filter and animate NetCDF files (either one file with several time steps, or several files each with one time step);
4. Generate a time series graph for a particular cell
5. Generate a section view of three dimensional data
5. Export the data to a shapefile; and
6. Access remote files using the OPeNDAP protocol.

This guide provides examples on using these tools to look at sample data included with the installation. There are 5 examples:

Sample 1 – Gulf of Mexico
This is an example of integrating rectangular NetCDF data from the U.S. Navy's wave model WAM, the hydrodynamic model SWAFS, and a NOAA meteorological model NAM (formerly referred to as ETA), This example shows the integration of multiple sources, each with different time steps, resolutions, and domains and the ability to display vector and scalar parameters

Sample 2 – Australia
This example shows how to integrate multiple oceanographic NetCDF files where each file contains a separate time step.

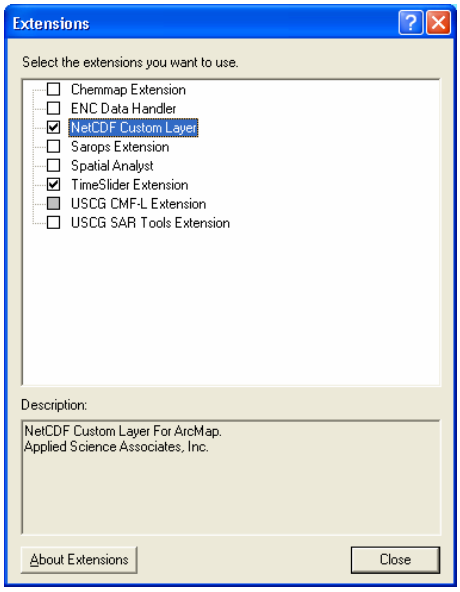
Sample 3 – Tampa Bay
This example shows the integration of non-rectangular hydrodynamic model (ECOM) data for Tampa Bay. It then includes oil spill model trajectory fields and other model data that is stored in ESRI SHP file format as an example of integrating NetCDF data with time-varying GIS-format data.

Sample 4 – Long Island Sound
This is an example of integrating model complex NetCDF data where the grid changes over time (probability grid), moving particles stored in NetCDF, as well as current data from a triangular mesh and wind data from a rectangular grid. This data was all generated with the Unites States Guard SAROPS system.

Sample 5 – OPeNDAP
This is an example of connecting to a U.S. Navy OPeNDAP server to directly read and render data from the server.

NetCDF is a complex file format with many unique conventions. In general, we aim to support NetCDF data that is CF and COARDS compliant. .

Getting Started in ArcMap 9

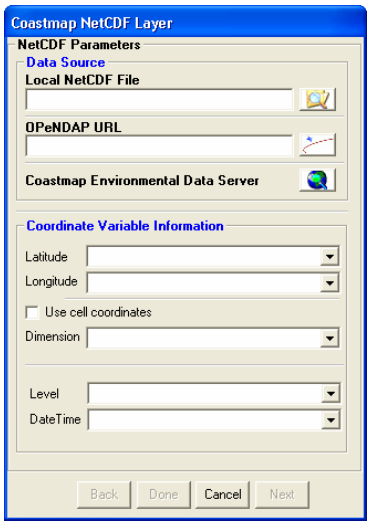


1. When you open a new ArcMap project, you will need to enable the NetCDF and TimeSlider extensions. To do this select "Extensions…" from the "Tools" menu.

2. Add a check to the boxes next to these two extensions to enable them.

3. The "TimeSlider" is easily docked into the bottom of the ArcMap window.

Sample 1- Gulf of Mexico

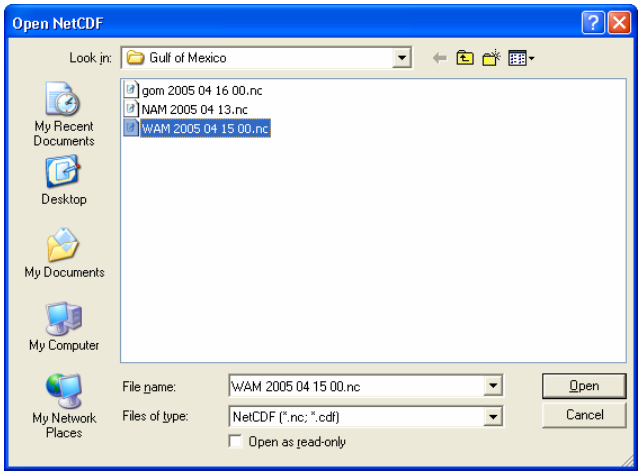


1. Open ArcMap and enable the NetCDF and TimeSlider extensions, if not done so already.

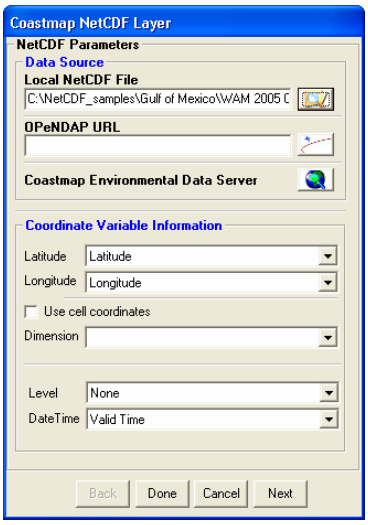
2. Before you incorporate any NetCDF data, you may want to add a base map of the Gulf of Mexico region for your reference.

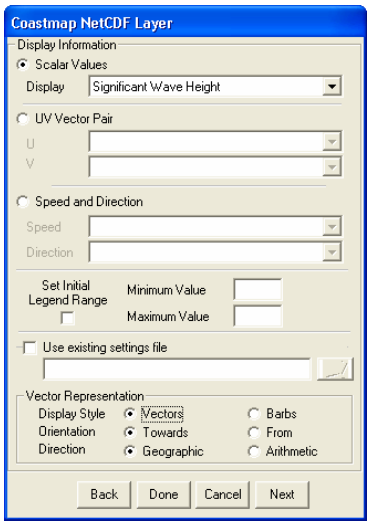
3. To incorporate NetCDF data into a project select the "Coastmap NetCDF" icon. 
This will open the NetCDF extension and display the "Coastmap NetCDF Layer" form.

4. To select a local NetCDF file, click on the  button. Use the Open NetCDF dialog box to navigate to the desired C:\NetCDF_samples\Gulf of Mexico directory and choose the wave file named "WAM 2005 04 15 00.nc" and click the "Open" button.



5. Once the NetCDF file is selected, specify the parameters that represent the coordinate information for Lat/Lon. Some non rectangular NetCDF files will also require the user to specify the ncell dimension.





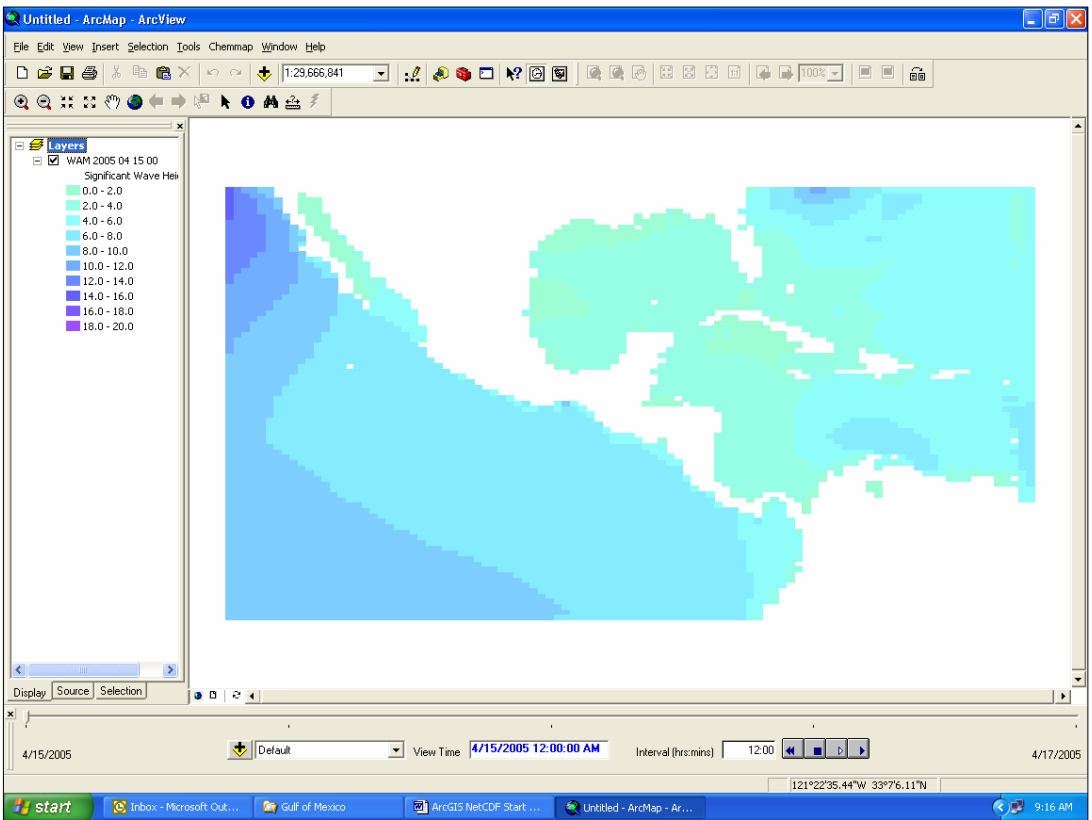
6. Specify the parameters for DateTime and Level. Note in many cases the NetCDF extension will recognize the parameter names and intuitively fill these parameters automatically for you.

   The extension should automatically fill the correct values for Latitude and Longitude and "None" for the "Level". Once the parameters have been filled, click the "Next" button.

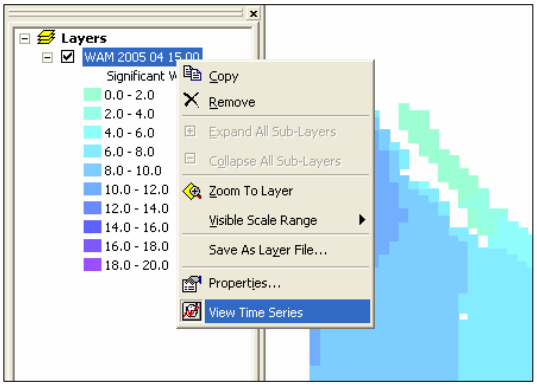
7. You are presented with a number of options to select either scalar or vector data. The first dropdown box lets you select appropriate scalar field to be displayed (e.g. inferred salinity or sea surface temperature). The next option allows you to select vector data using the U and V fields or you can define a speed and direction if the data is available.

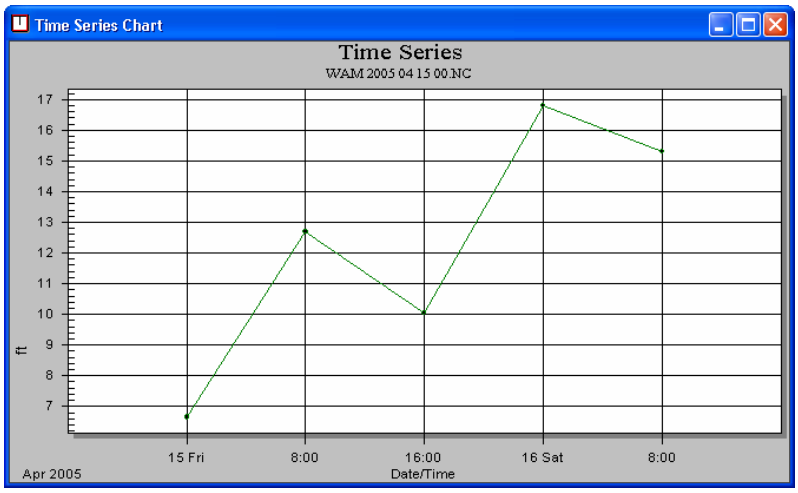
   To manually specify the range of data to be displayed, click on the box marked "Set Initial Legend Range". Then specify the minimum and maximum values for the data.

8. For this sample, the extension should automatically select "Scalar Values" under the "Display Information" option. Select "Significant Wave Height" from the drop-down menu.



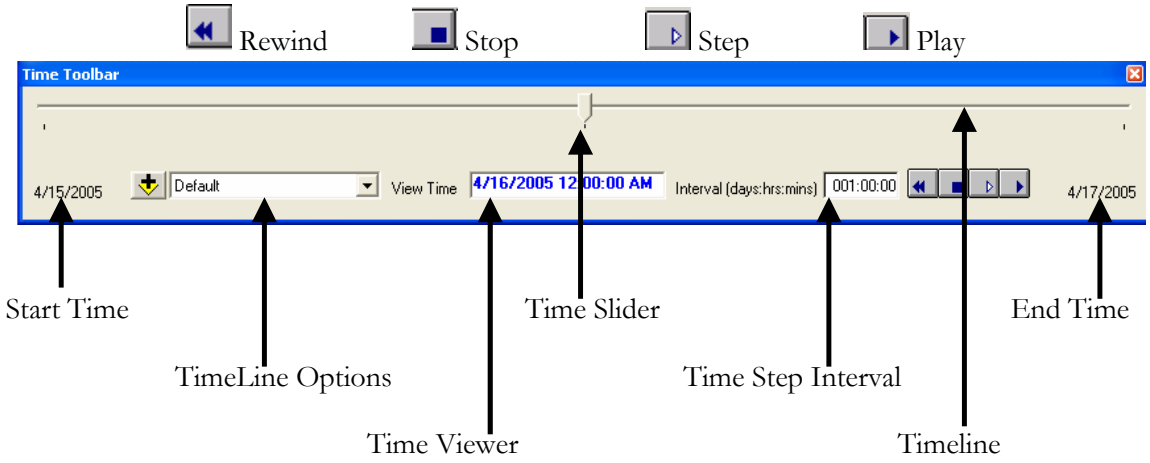
10. The NetCDF ArcGIS extension gives you the ability to interrogate points or grid cells to extract time series data. Right click on the NetCDF layer and select the View **Time Series,** then use the mouse to interrogate the cell or point for which you want to graph a time series.





11. As each NetCDF file was incorporated into ArcMap, it was also incorporated into the TimeSlider. Each file has a series of Time Steps that occur at a certain interval. The TimeSlider reflects the Start and End Time for each Time Series and places a tick mark along the Timeline at each time step. It also displays the Time Step date and time in the Time Viewer and the interval between Time Steps.

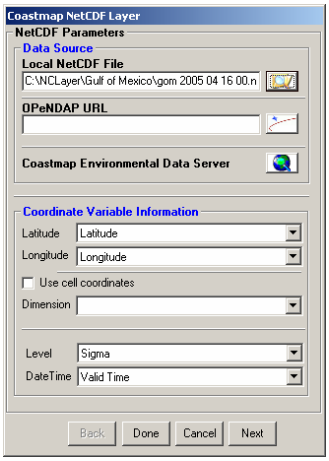
    For example, the "WAM 2005 04 15 00.nc" time series begins at 4/15/2005 12:00 AM and ends at 4/17/2005 12:00 AM. It has an interval of 12 hours and so it has five time steps, 4/15/2005 12:00 AM, 4/15/2005 12:00 PM, 4/16/2005 12:00 AM, 4/16/2005 12:00 PM, and 4/17/2005 12:00 AM.

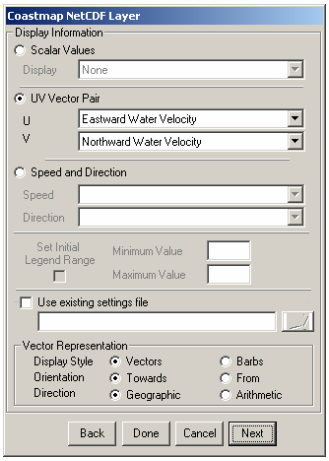


12. You may play the animate Times Series from start to finish by clicking the "Play" button, or you may view one frame at a time by clicking the "Step" button.

13. Now we can add a second data set to ArcMap.

Add a surface current file called "gom 2005 04 16 00.nc that is stored in the same Gulf of Mexico folder".



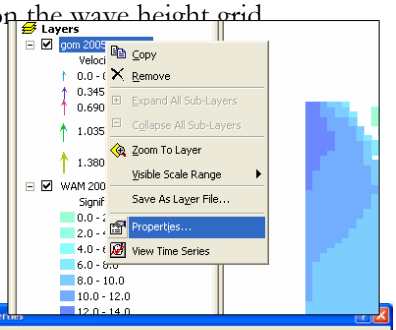


14. The Latitude and Longitude options should be selected automatically as well as a "Sigma" Level and "Valid Time" under DateTime. Click Next.

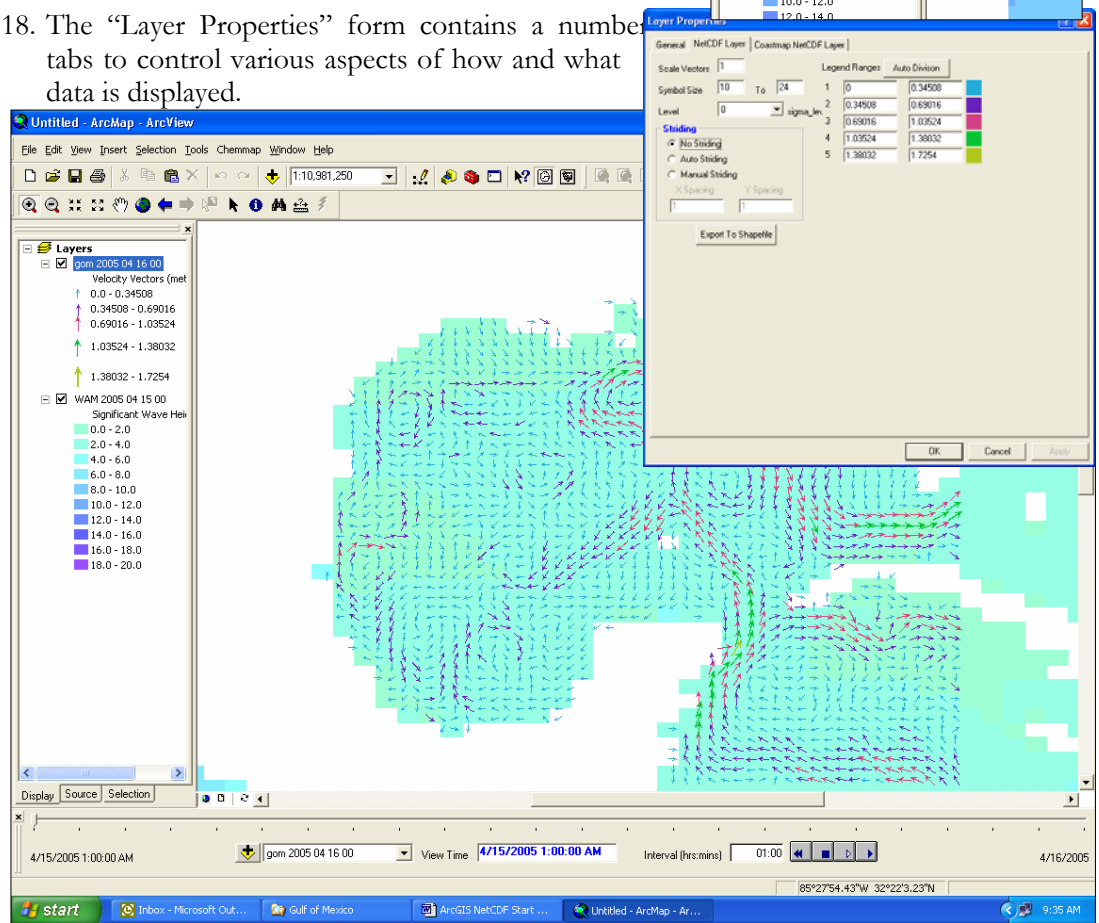
15. The "Display Information" should be "UV Vector Pair" with Eastward and Northward Water Velocities selected. The Vector Representation should be "Vectors" under Display Style. Click Done.

16. The data may not be displayed in the map after you add it. This is because the Time Series for this currents file begins after the Time Step currently selected on the Timeline. If you Step forward the vectors should appear overlaid on the wave height grid.

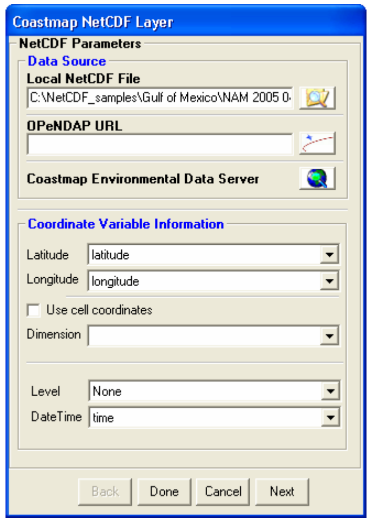
17. To change or edit the layer properties, double click on the layer or right click on the desired layer and select "Properties" from the menu option. This will open the "Layer Properties" form.

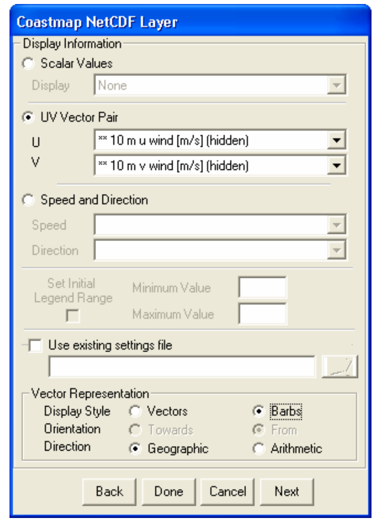


18. The "Layer Properties" form contains a number tabs to control various aspects of how and what data is displayed.

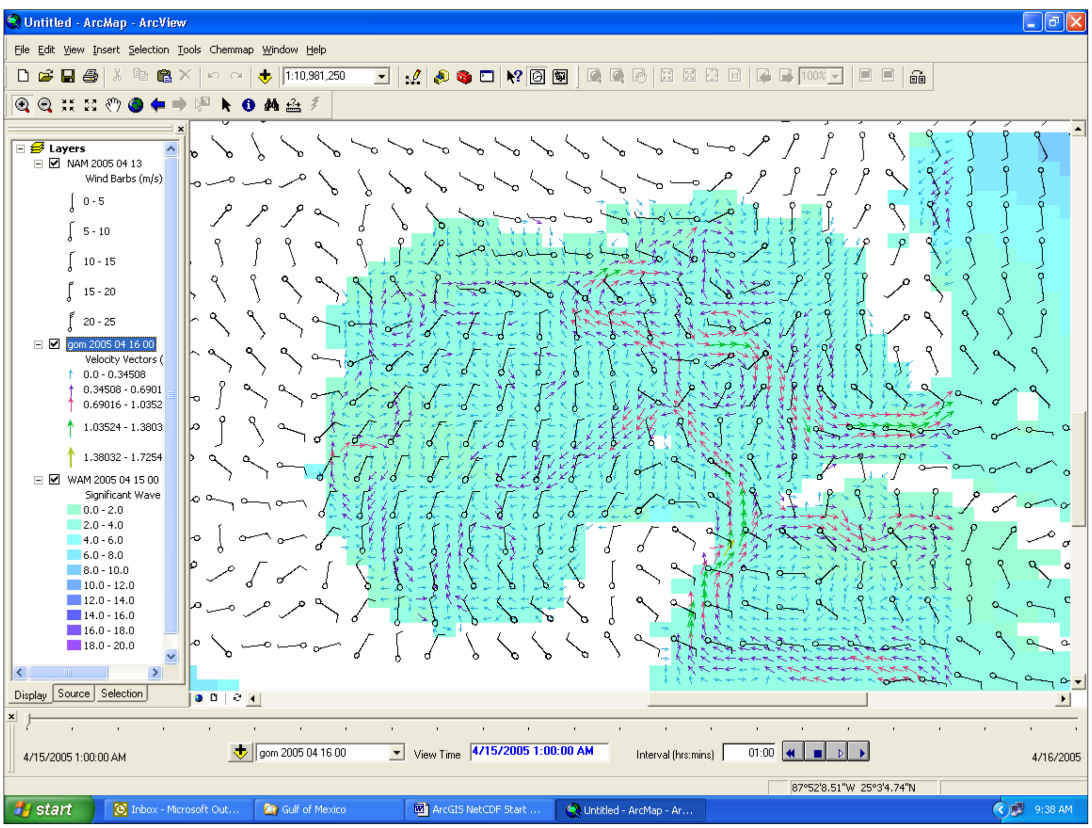


19. Finally, we can add a NetCDF data file with surface winds. This file is named "NAM 2005 04 13.nc" and is also found in the Gulf of Mexico folder.





As with the other files, the Latitude and Longitude values should be correctly chosen for you along with the UV Vector Pair. Under Vector Representation, you will want to display the vectors as Barbs. Click Done.



20. Each of the three files has a different Time Series, with varying start and end times and intervals. However, you can view the three files together in an animated Time Series because the TimeSlider merges all time varying data.

    The Default timeline is the master time line that combines all data included, showing the total temporal extent of the data using the longest time interval and the largest time step of all 3 files.

    You can also view the data using one the data set's individual Timeline's by choosing it from the drop-down menu.

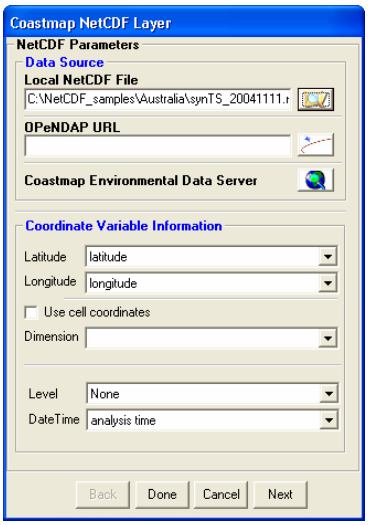
Sample 2- Australia

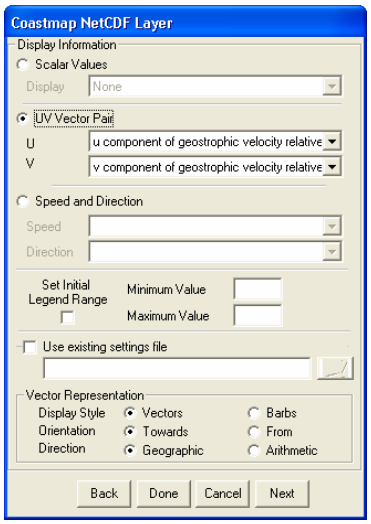
1. Open ArcMap and enable the NetCDF and TimeSlider extensions, if not done so already.

2. Add a base map of Australia to your project for reference

3. Add your first NetCDF file to your project. Navigate to the C:\NetCDF_samples\ Australia directory and choose the file named "synTS_20041111.nc."

   The Coordinate Variable Information should have the Latitude and Longitude information selected.



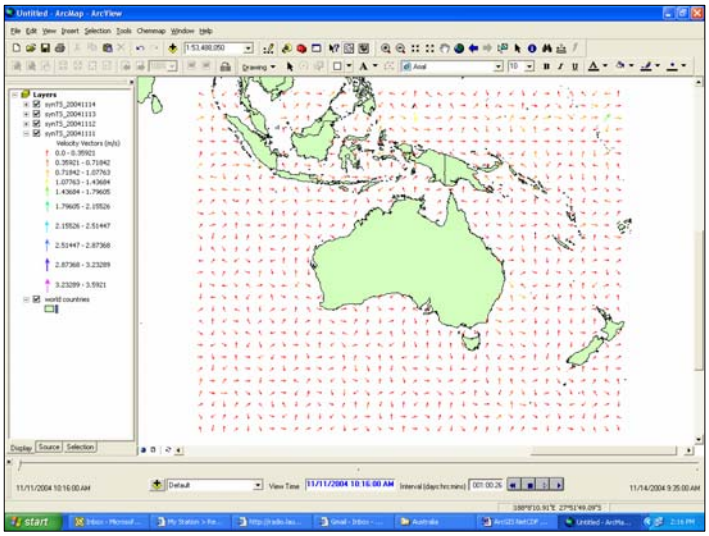


   The "Display Information" should be "UV Vector Pair" with appropriate components selected. Do not select any additional fields to add. Click Done.

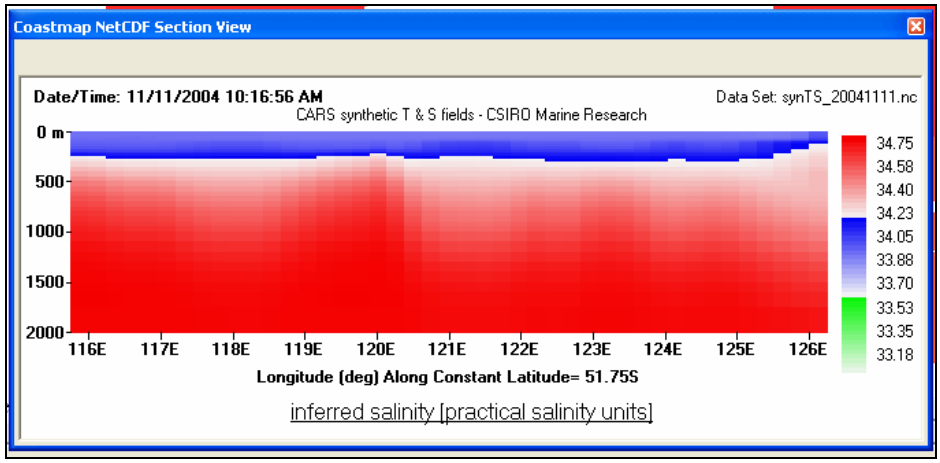
4. When the file is incorporated in the ArcMap project, they will be display with "Auto Striding." Given the size of this file, you may prefer to leave this option selected.

5. As you incorporate the other NetCDF files in the Australia folder, use the same parameters as the first file.

6. The surface currents NetCDF data files were collected on four consecutive days. Unlike the NetCDF files that were used in the previous demo, these files have only one Time Step each. You can still animate them as long as the "Default" Timeline is selected in the drop-down menu.



7. Where 3D NetCDF data is available, the NetCDF ArcGIS extension gives you the ability to draw a transect on the map and create a section view of the data. Change the properties of the "synTS_20041111.nc." file using **Depth** as the level and **Salinity** as the scalar value. Right click on the layer in the Table of Contents and select **Section View,** then use the mouse to draw a transect on the map, clicking once to start the transect and double clicking to end it.

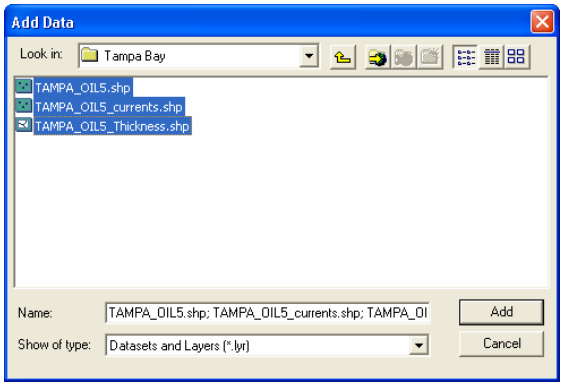


Sample 3- Tampa Bay

1. Open ArcMap and enable the NetCDF and TimeSlider extensions, if not done so already.

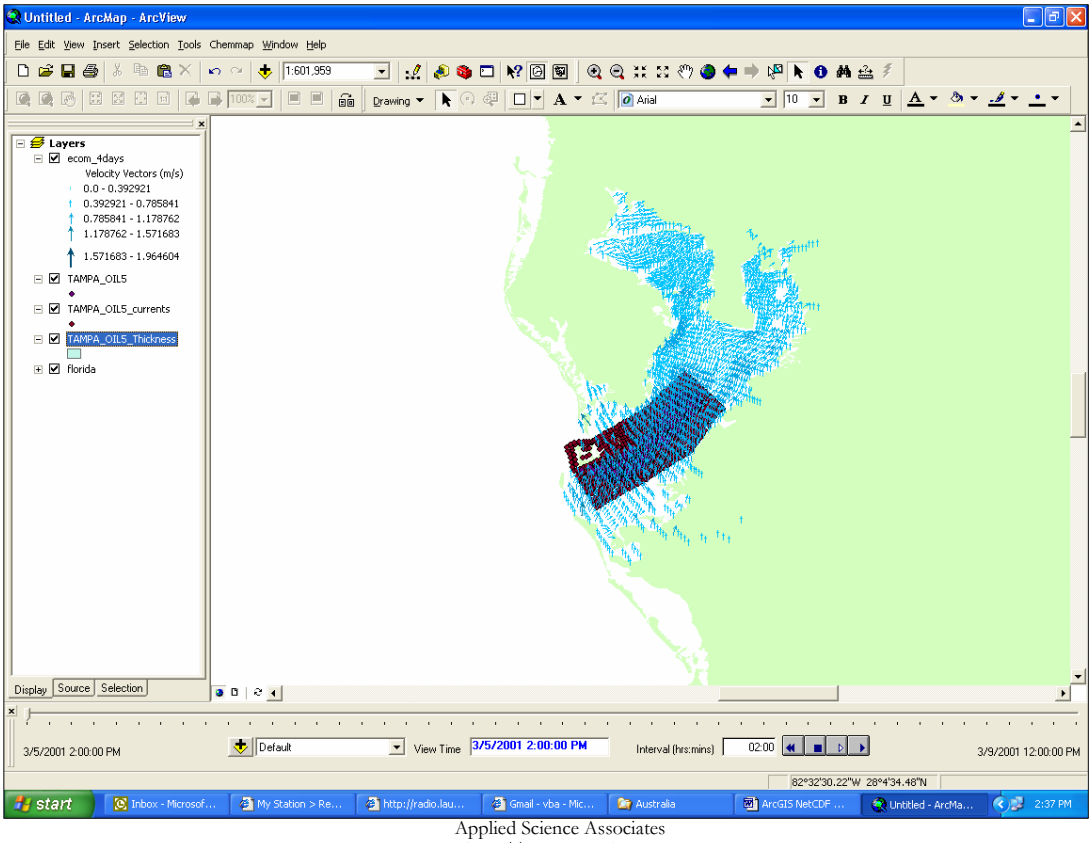
2. Add a base map of the Tampa Bay area to your project for reference.

3. Now we will add some current data and an oil spill model trajectory. These are standard SHP files so we will not use the NetCDF tool but add standard SHP files. Click the ArcGIS "Add Data" icon to add the three shapefiles from the C:\NetCDF_samples\Tampa Bay directory.

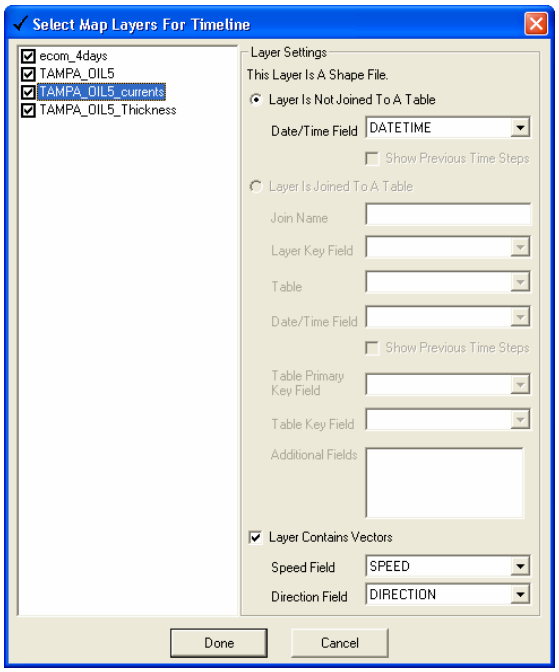


These shapefiles include Date/Time attributes and therefore can be added to the TimeSlider and be viewed in a Time Series along with the NetCDF data.

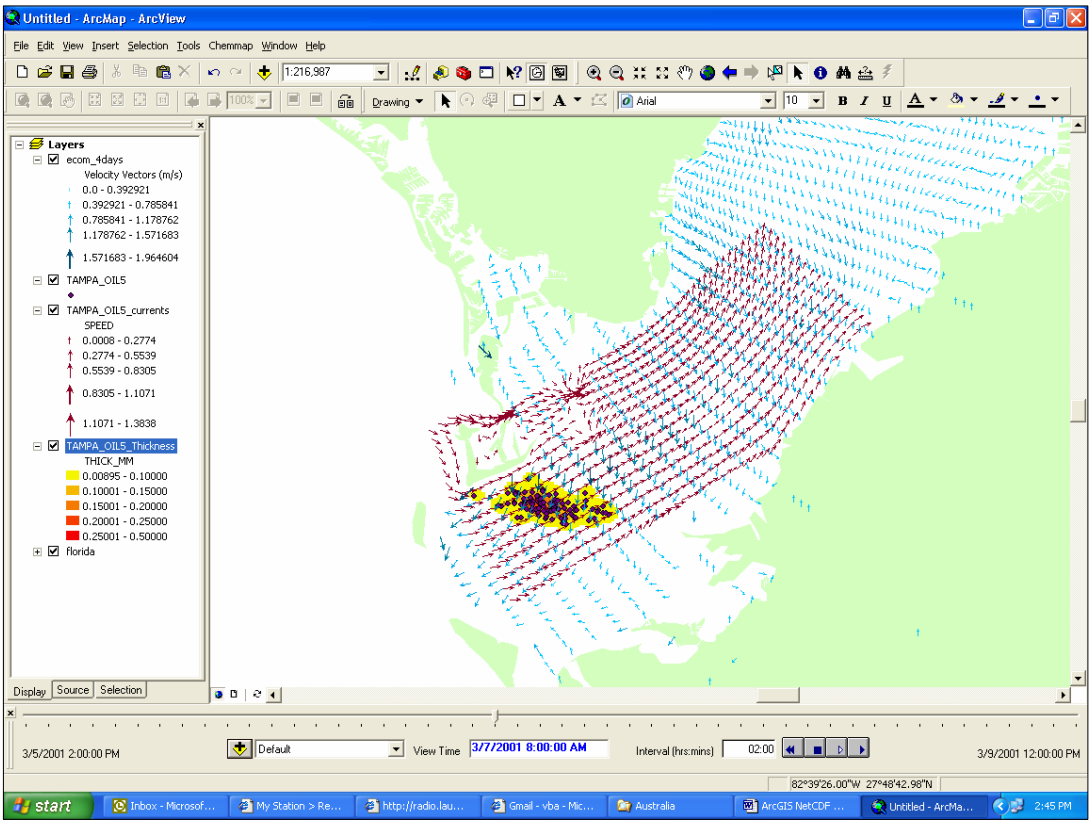
When the three shapefiles are added to the map window, they may not have the appropriate symbology (i.e. points instead of vectors). This will be corrected in the next step for the vectors. However, you may want to change the symbology for the "TAMPA_OIL5_Thickness" file now, displaying it with graduated colors and readjusting the class breaks using Manual Classification.



4. Click the "Add Data" icon on the TimeSlider. This will add the shapefiles to the TimeSlider. Check the box next to each of the shapefiles. Under the "Layer Settings", the Date/Time Field should automatically be filled with the appropriate option for all three shapefiles. However, for "TAMPA_OIL5_currents" you will have to check the box next to "Layer Contains Vectors." The Speed and Direction fields should automatically and correctly be chosen. Click Done.



5. The NetCDF data and the shapefiles can now be viewed together by using the TimeSlider.



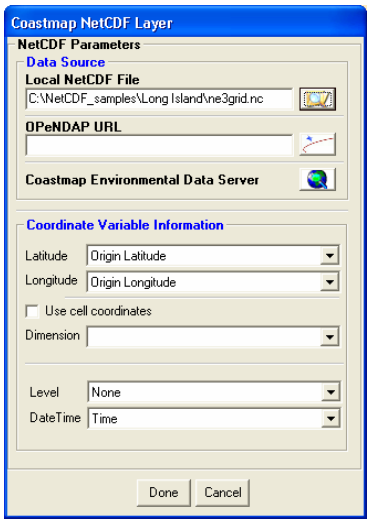
Sample 4- Long Island

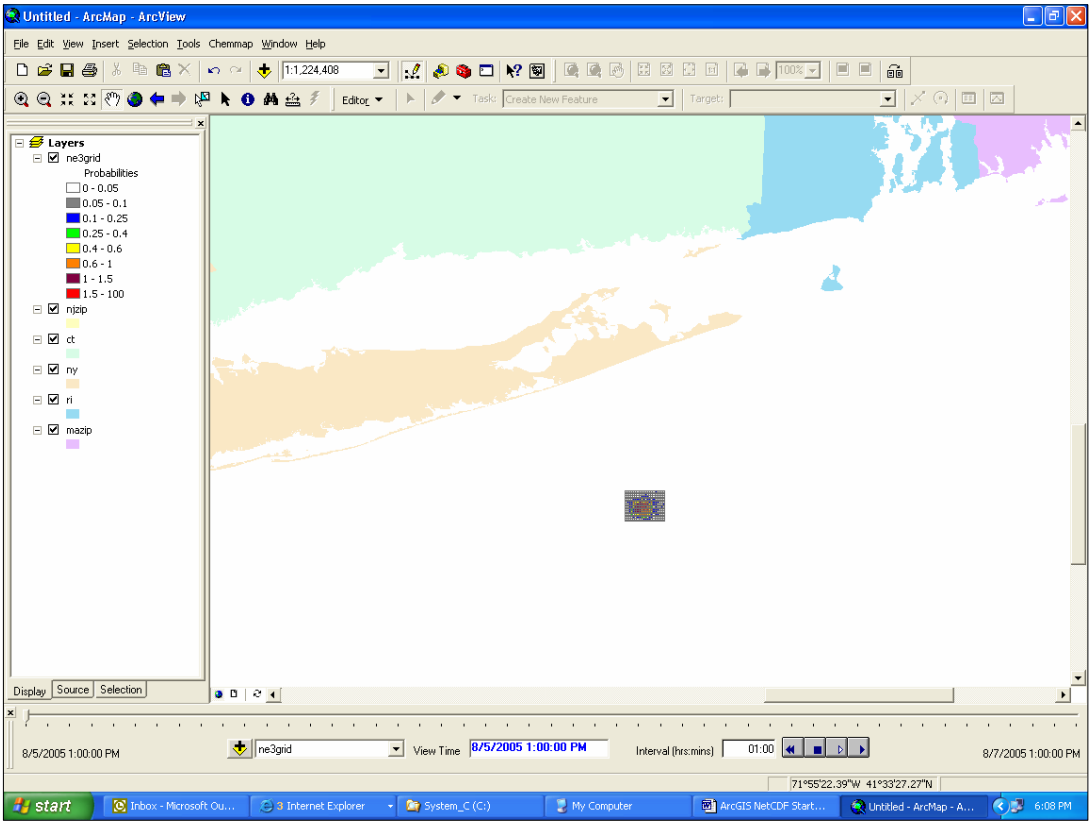
1. Open ArcMap and enable the NetCDF and TimeSlider extensions, if not done so already.

2. Add a base map of the Long Island area to your project for reference.

3. We will add a moving probability grid generated by a search & rescue model. Use the NetCDF tool to add "ne3_grid.nc." from the C:\NetCDF_samples\Long Island directory.

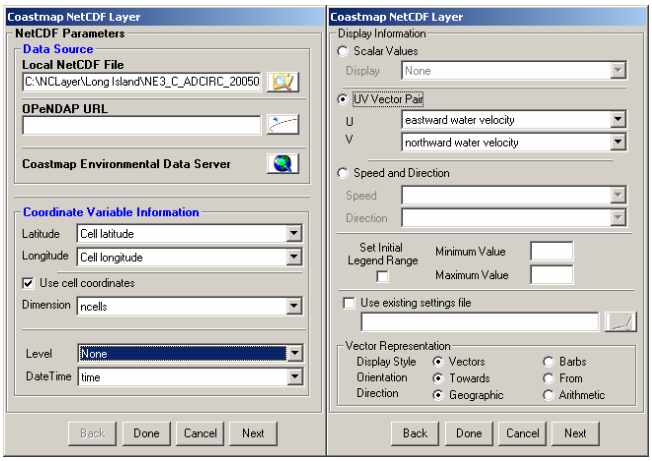
   The correct Latitude and Longitude should automatically be chosen under "Coordinate Variable Information." Click Done.

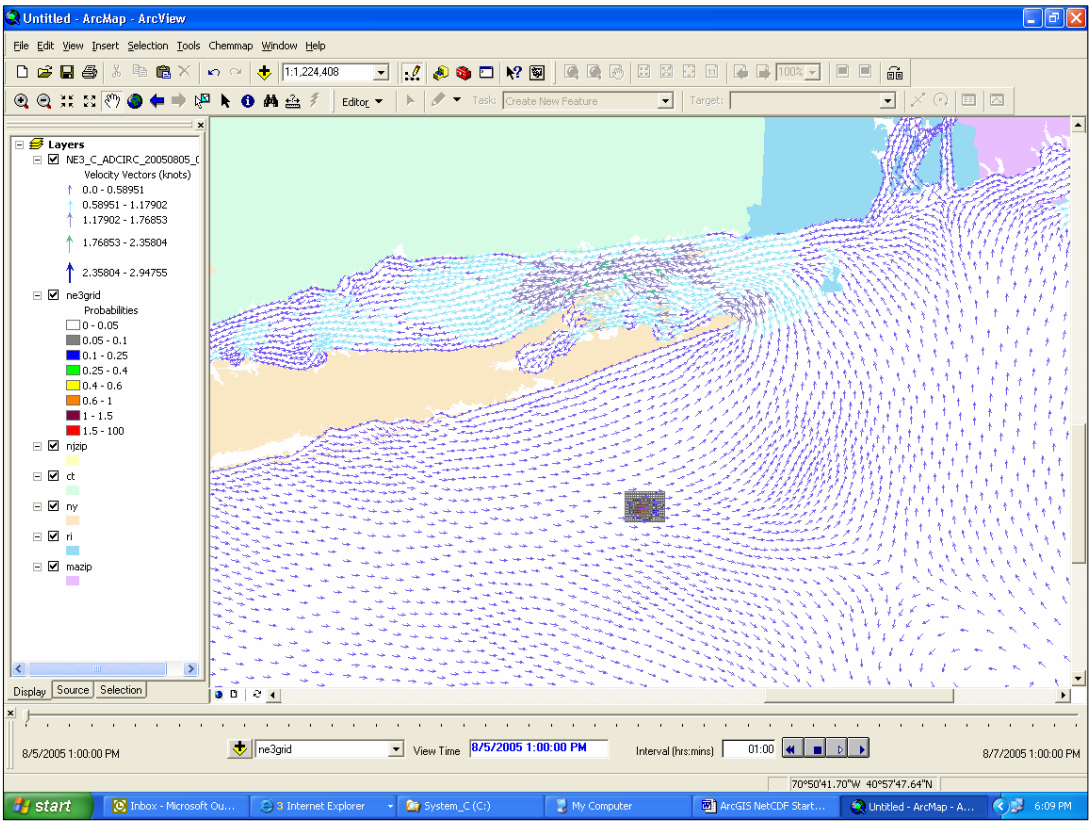




4. Now we will add surface current data generated from the ADCIRC model. Add "NE3_C_ADCIRC_20050805_0917.nc".
Under Coordinate Variable Information" and "Use ncell coordinates" should automatically be chosen.
None must be selected for Level.

"UV Vector Pair" and the correct options should be automatically chosen as well. Click Done.

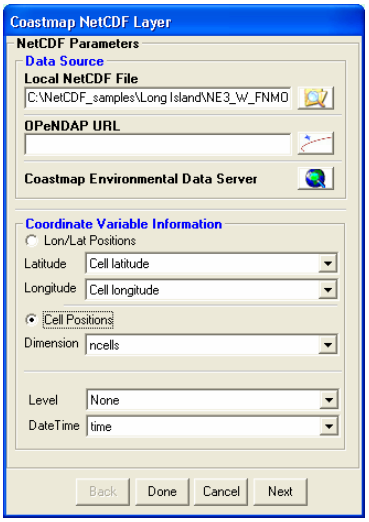


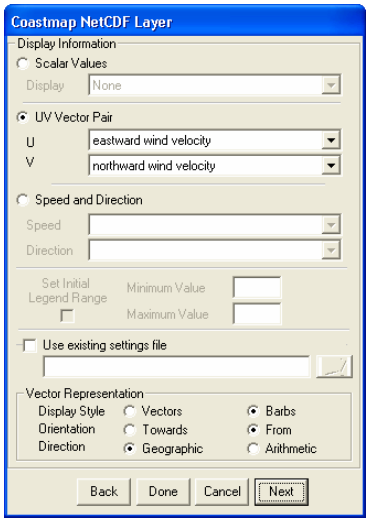


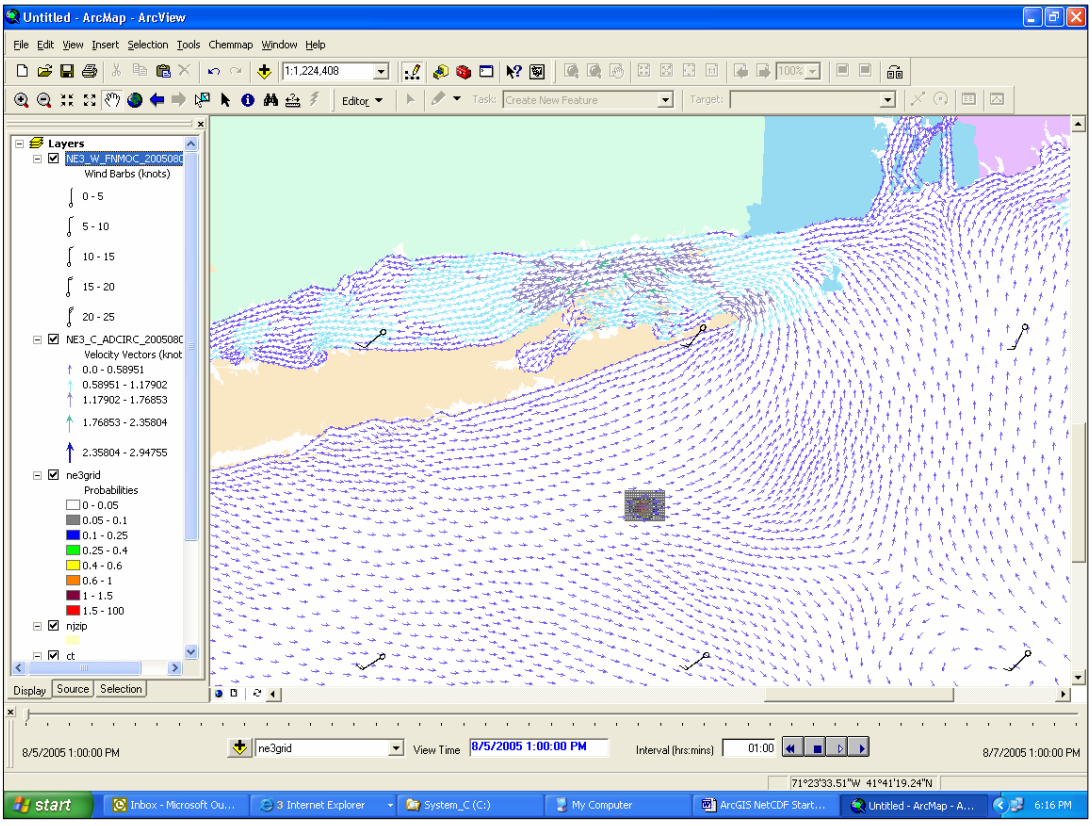
5. Add the wind file named "NE3_W_FNMOC_20050805_0854.nc".

   Choose "Use Cell Coordinates" under "Coordinate Variable Information" and "ncells" should automatically be chosen.

   "UV Vector Pair" and the correct options should be automatically chosen as well. Make sure "Barbs" are chosen under "Vector Representation." Click Done.

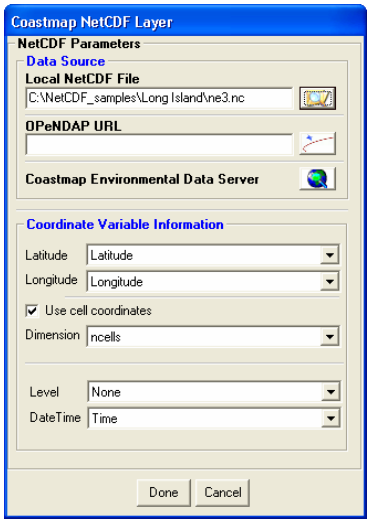




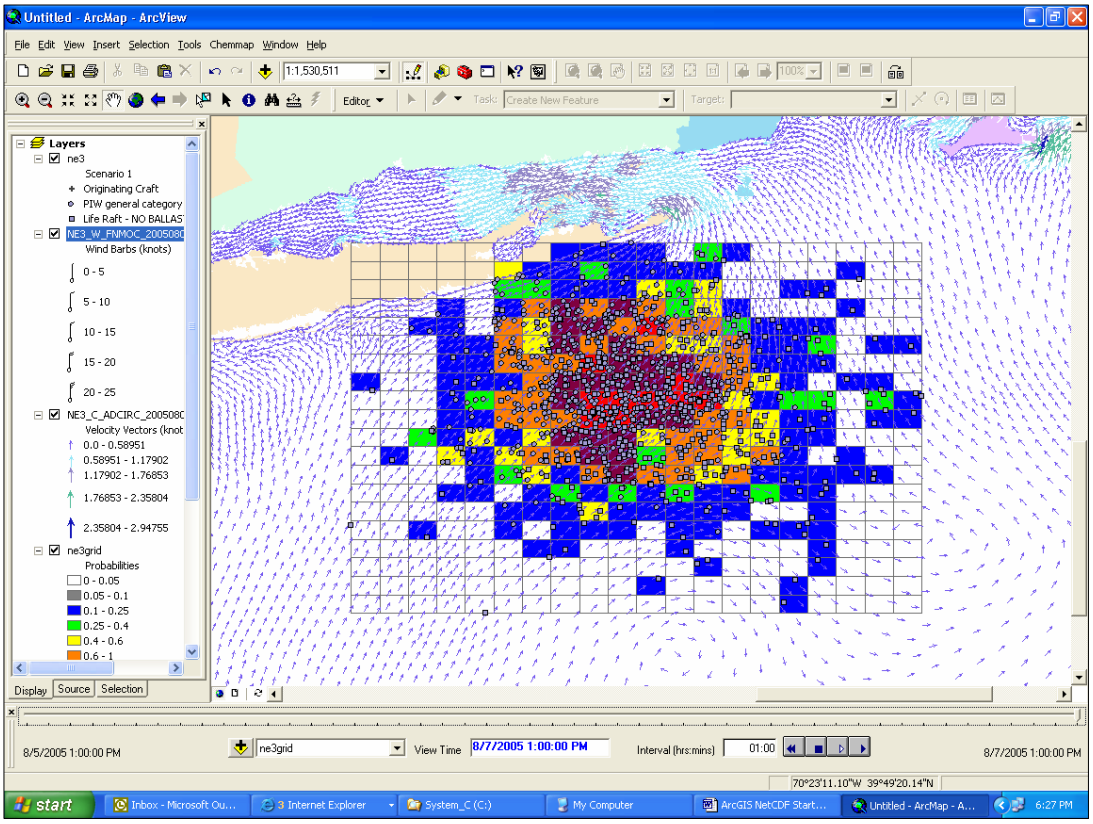


6. We can also add an example of a moving particle file, "ne3.nc."

   The correct Latitude and Longitude options should appear automatically. Click Done.



7. You can now use the TimeSlider to view the files associated with Search and Rescue case in a time animation.

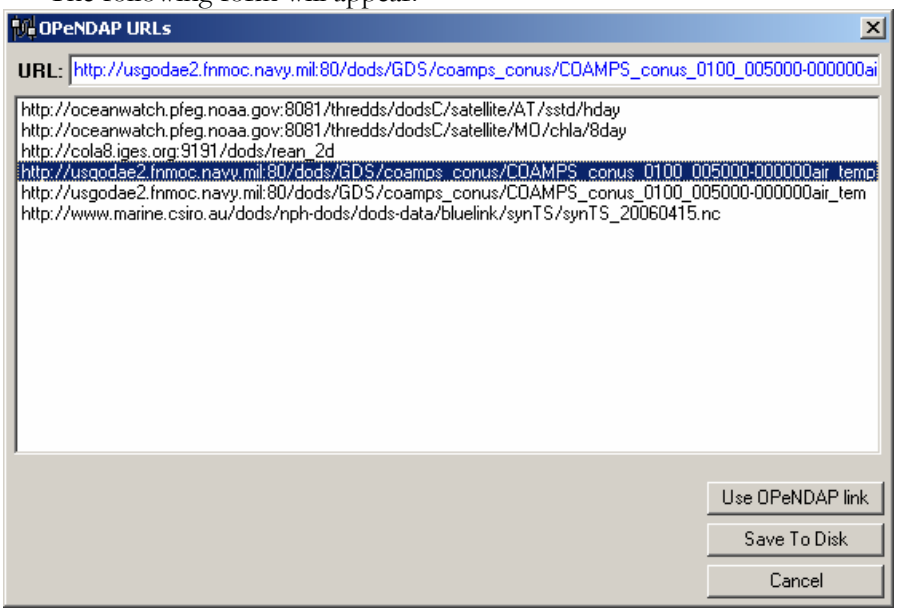


Sample 5- OPeNDAP Functionality

OPeNDAP is a server and transport technology for delivering large amounts of data in an efficient manner. It can serve many formats including NetCDF, GRIB, and HDF. (For more information, see http://www.opendap.org).

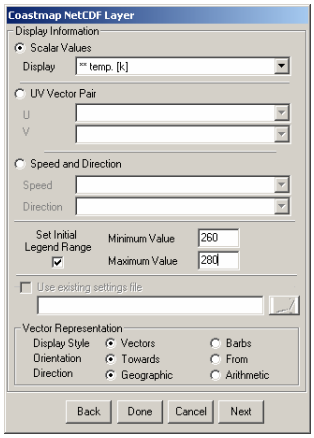
OPeNDAP functionality has been included with the Coastmap NetCDF Layer extension, and we will outline how to connect to an OPeNDAP server hosted at GODAE and serving FNMOC data. It is important to note that no data will actually be downloaded to your desktop as the viewer will actually read and render data directly from the OPeNDAP server when needed.

1. On the NetCDF tool, Click on the OPeNDAP button. 
   The following form will appear:



Use this Opendap server link.

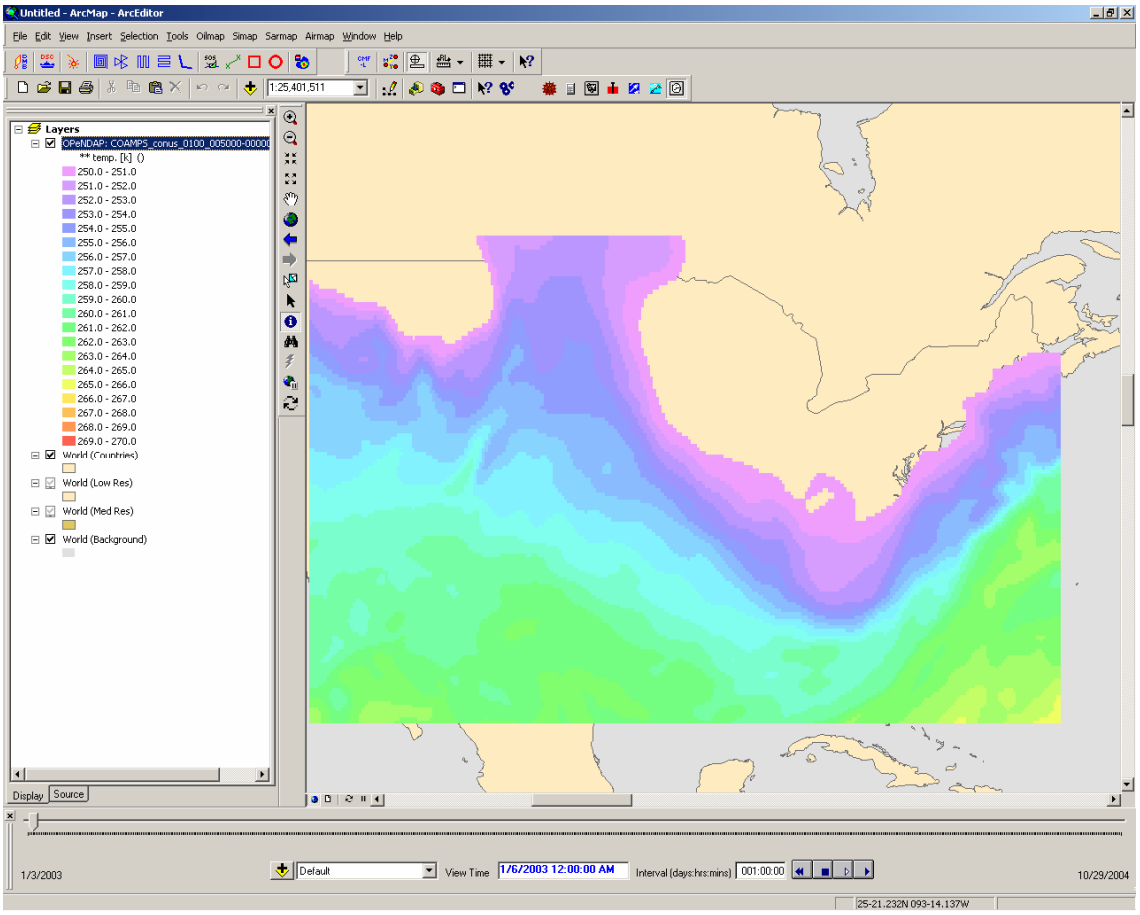
2. Type in the following URL:
   http://usgodae2.fnmoc.navy.mil:80/dods/GDS/coamps_conus/COAMPS_conus_0100_005000-000000air_temp



3. After you click Use Opendap Link, the dialog will display the fields available for viewing. Select the temperature field..

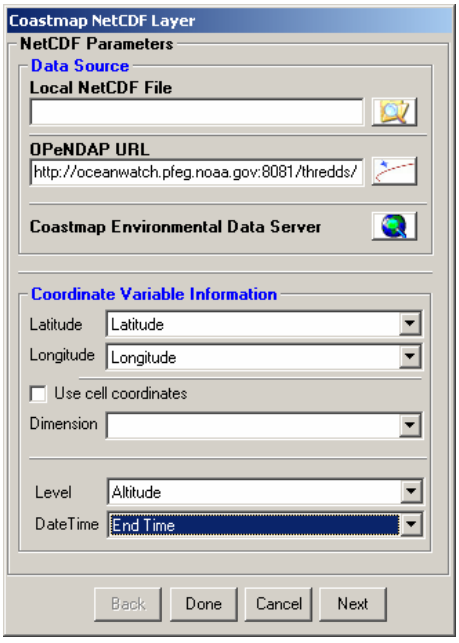
4. If you do not select the **Set Initial Legend Range**, the data will be scanned to determine minimum and maximum values, this may take a long time. For this data use a min of **250** and a max of **280**.

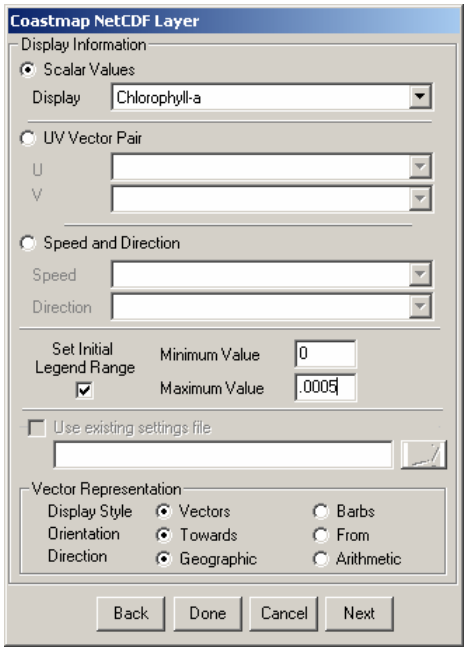
5. When you're finished, click "Done". The data will be rendered in ArcMap as if it were on your local machine. Please allow some time for the data access, as the speed will vary depending on your network.

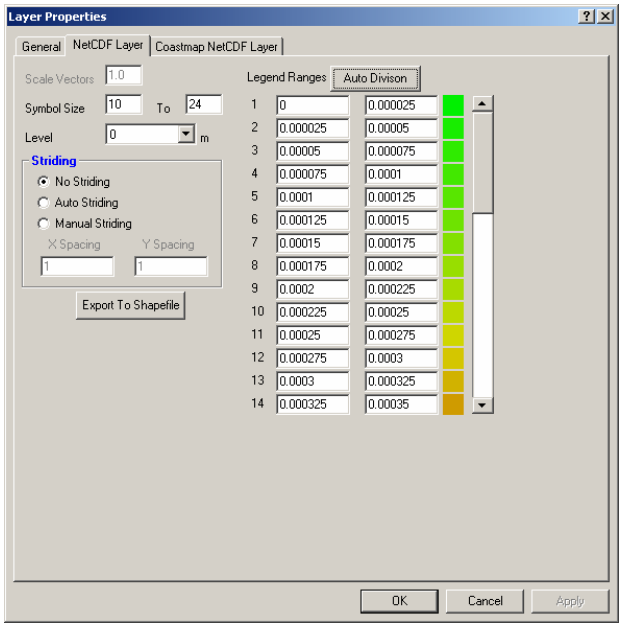

Untitled - ArcMap - ArcEditor
File Edit View Insert Selection Tools Oilmap Simap Sarmap Airmap Window Help
1:25,401,511
Layers
OPeNDAP: COAMPS_conus_0100_005000-00000
** temp. [k] ()
250.0 - 251.0
251.0 - 252.0
252.0 - 253.0
253.0 - 254.0
254.0 - 255.0
255.0 - 256.0
256.0 - 257.0
257.0 - 258.0
258.0 - 259.0
259.0 - 260.0
260.0 - 261.0
261.0 - 262.0
262.0 - 263.0
263.0 - 264.0
264.0 - 265.0
265.0 - 266.0
266.0 - 267.0
267.0 - 268.0
268.0 - 269.0
269.0 - 270.0
World (Countries)
World (Low Res)
World (Med Res)
World (Background)
Display Source
1/3/2003
Default
View Time
1/6/2003 12:00:00 AM
Interval (days:hrs:mins)
001:00:00
10/29/2004
25-21.232N 093-14.137W

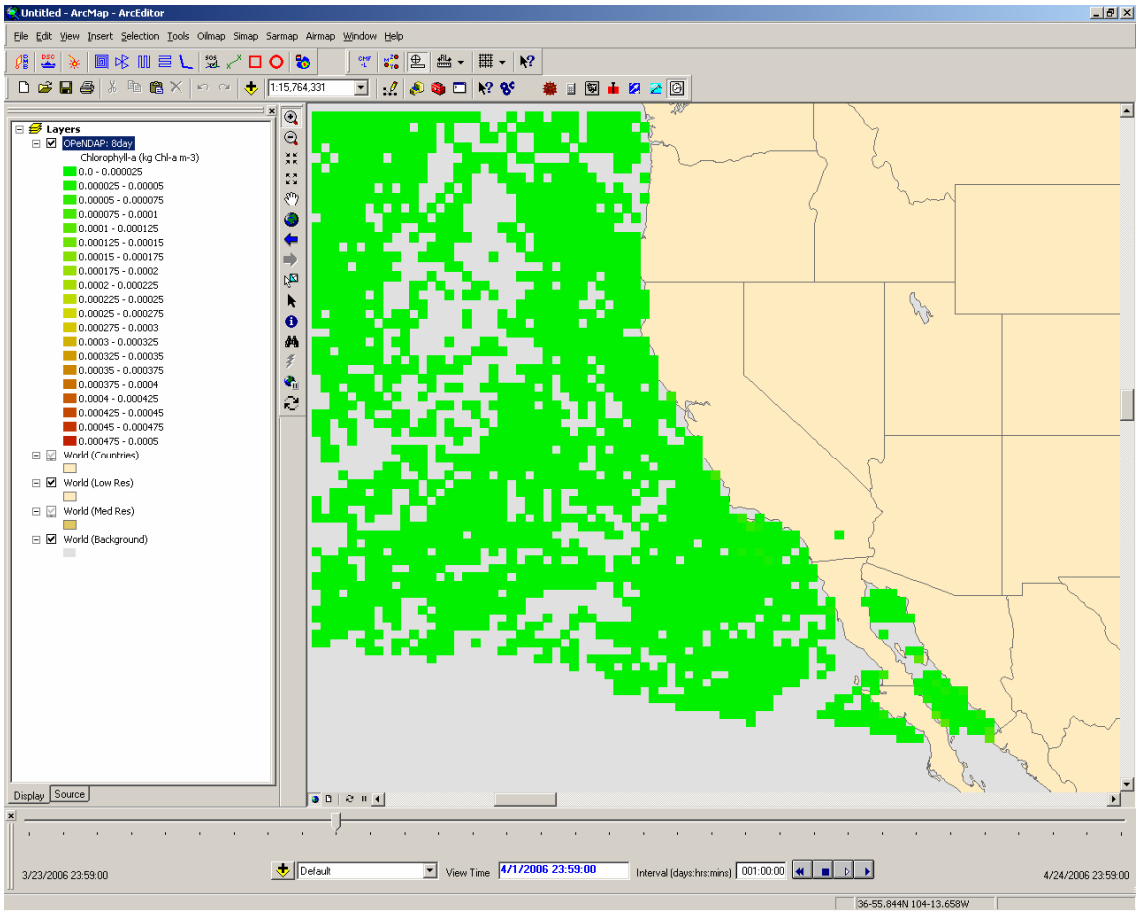
Other OPeNDAP Servers to try:

http://oceanwatch.pfeg.noaa.gov:8081/thredds/dodsC/satellite/MO/chla/8day

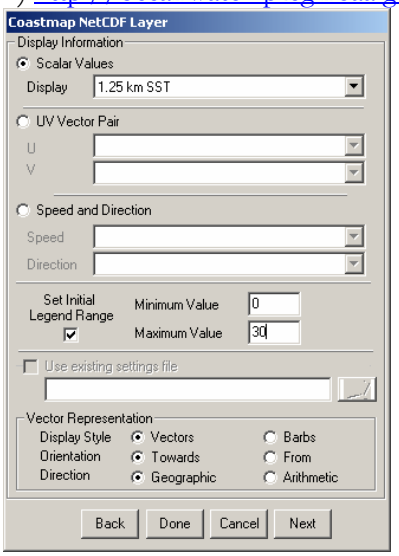


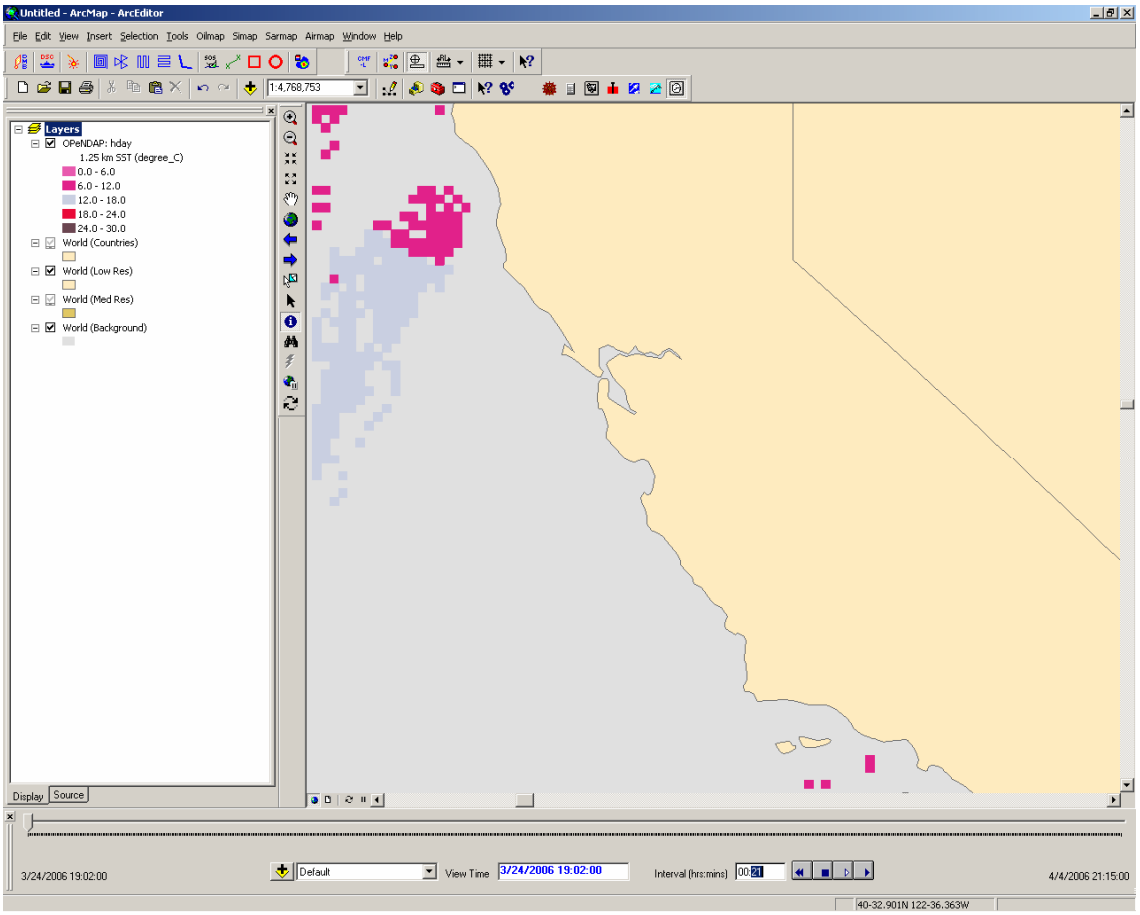


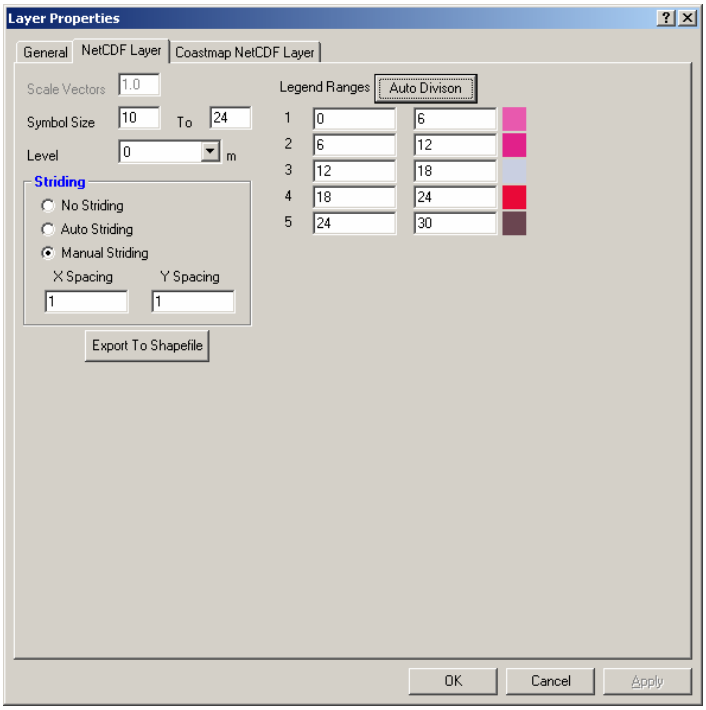


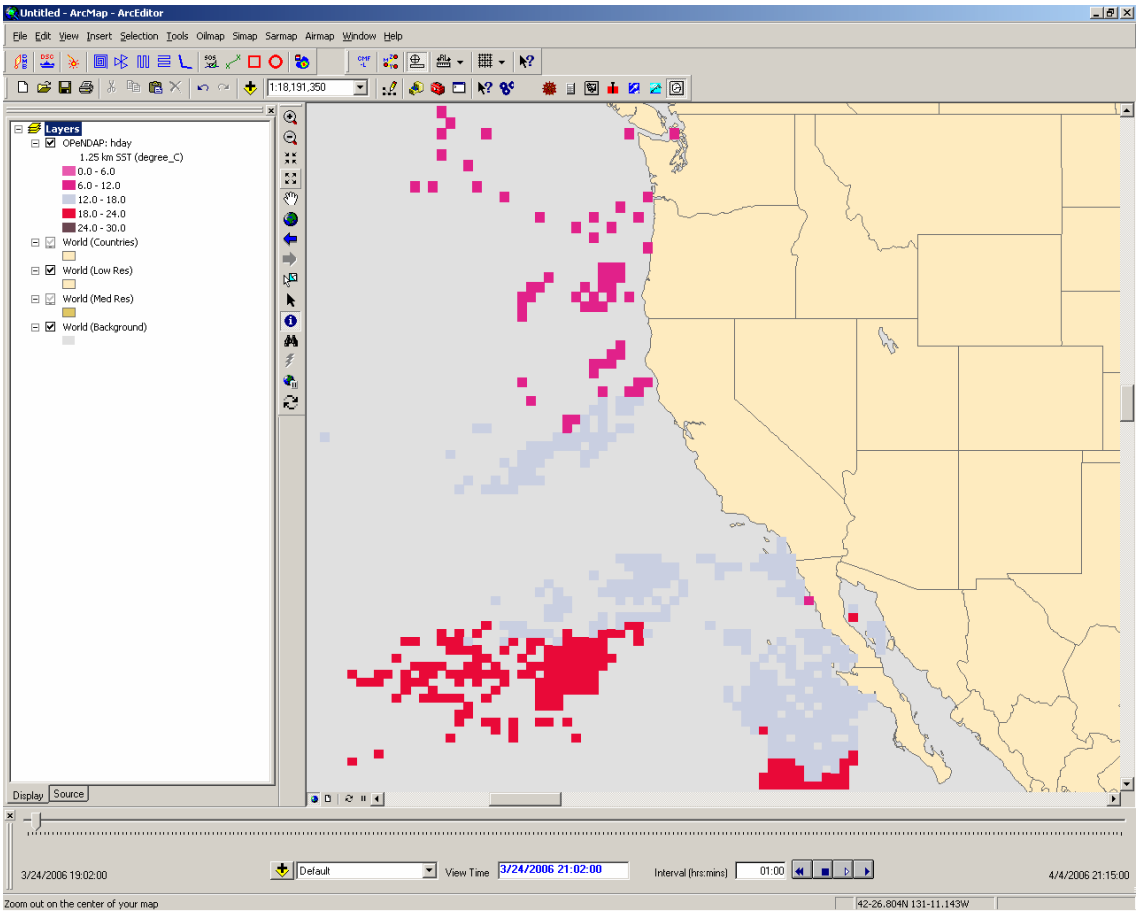

Untitled - ArcMap - ArcEditor
File Edit View Insert Selection Tools Olmap Simap Sarmap Airmap Window Help
1:15,764,331
Layers
OPeNDAP: 8day
Chlorophyll-a (kg Chl-a m-3)
0.0 - 0.000025
0.000025 - 0.00005
0.00005 - 0.000075
0.000075 - 0.0001
0.0001 - 0.000125
0.000125 - 0.00015
0.00015 - 0.000175
0.000175 - 0.0002
0.0002 - 0.000225
0.000225 - 0.00025
0.00025 - 0.000275
0.000275 - 0.0003
0.0003 - 0.000325
0.000325 - 0.00035
0.00035 - 0.000375
0.000375 - 0.0004
0.0004 - 0.000425
0.000425 - 0.00045
0.00045 - 0.000475
0.000475 - 0.0005
World (Countries)
World (Low Res)
World (Med Res)
World (Background)
Display
Source
3/23/2006 23:59:00
Default
View Time
4/17/2006 23:59:00
Interval (days:hrs:mins)
001:00:00
4/24/2006 23:59:00
36-55.844N 104-13.658W

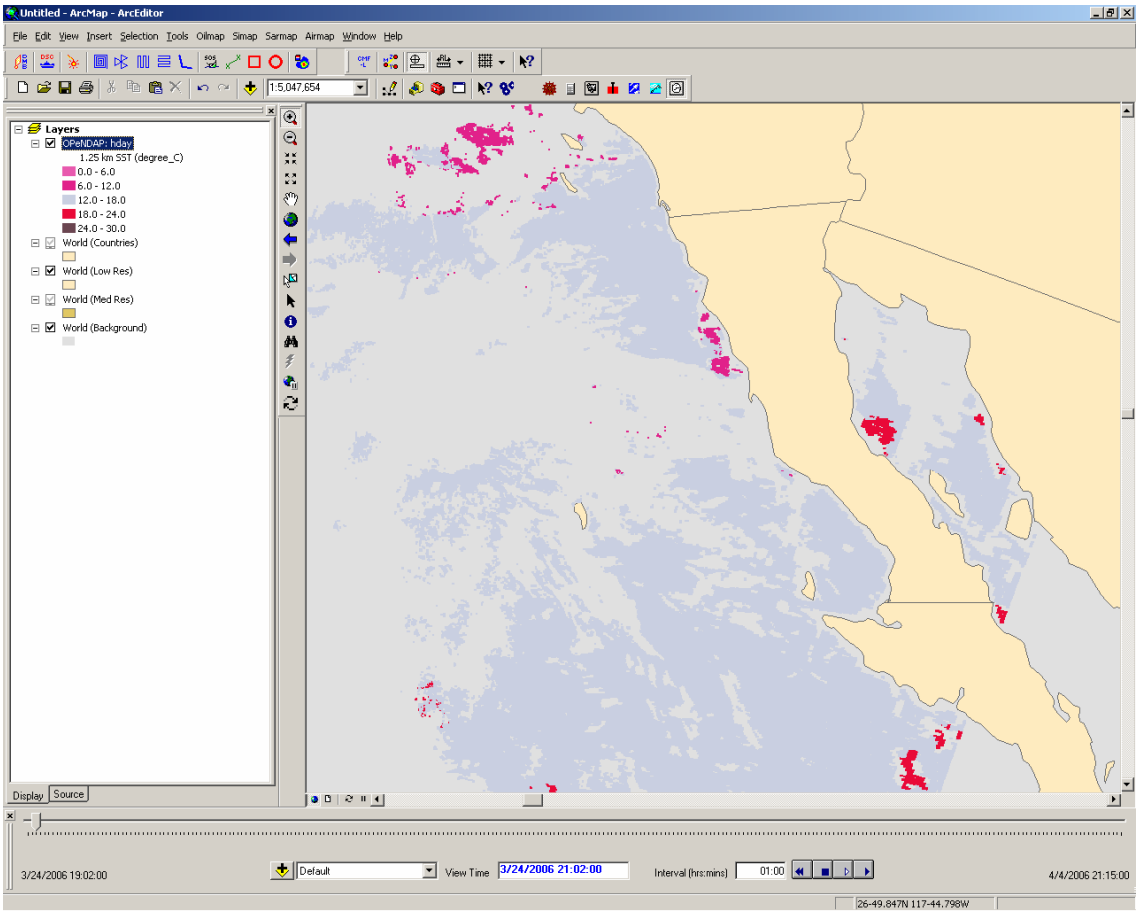
1) http://oceanwatch.pfeg.noaa.gov:8081/thredds/dodsC/satellite/AT/sstd/hday



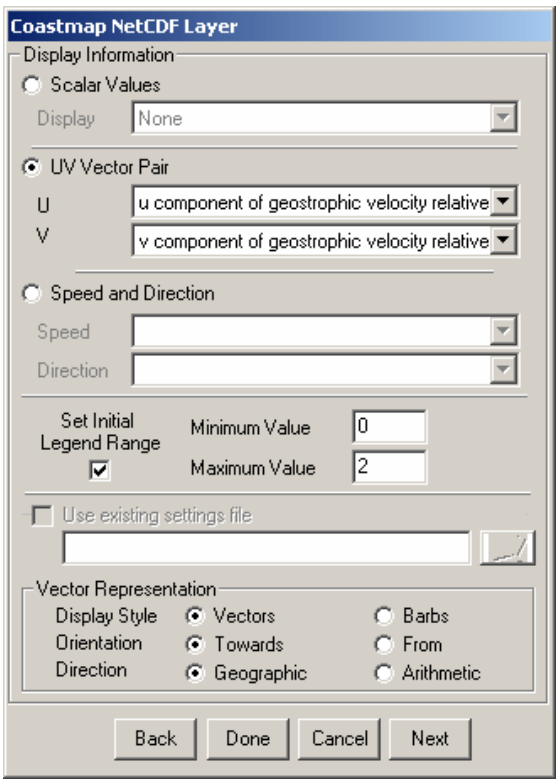


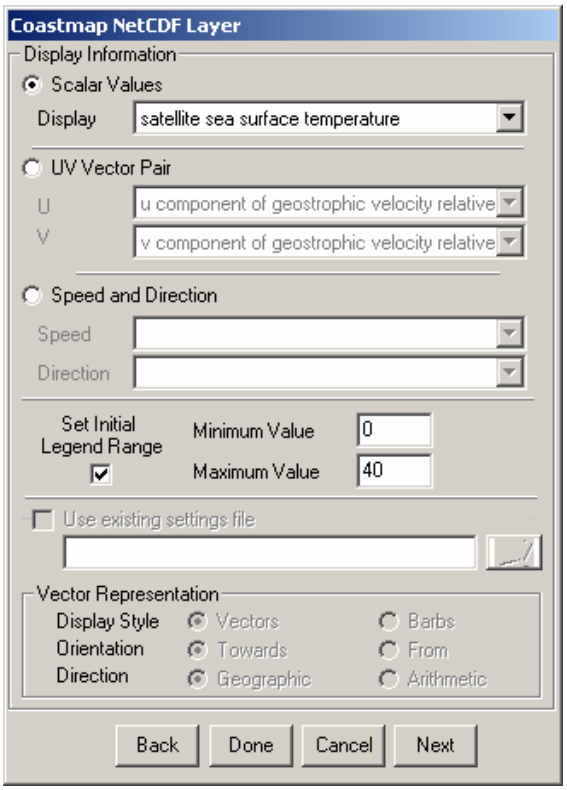

Layer Properties
General
NetCDF Layer
Coastmap NetCDF Layer
Scale Vectors
1.0
Symbol Size
10
To
24
Level
0
m
Striding
No Striding
Auto Striding
Manual Striding
X Spacing
Y Spacing
1
1
Export To Shapefile
Legend Ranges
Auto Division
1 0 6
2 6 12
3 12 18
4 18 24
5 24 30
OK
Cancel
Apply

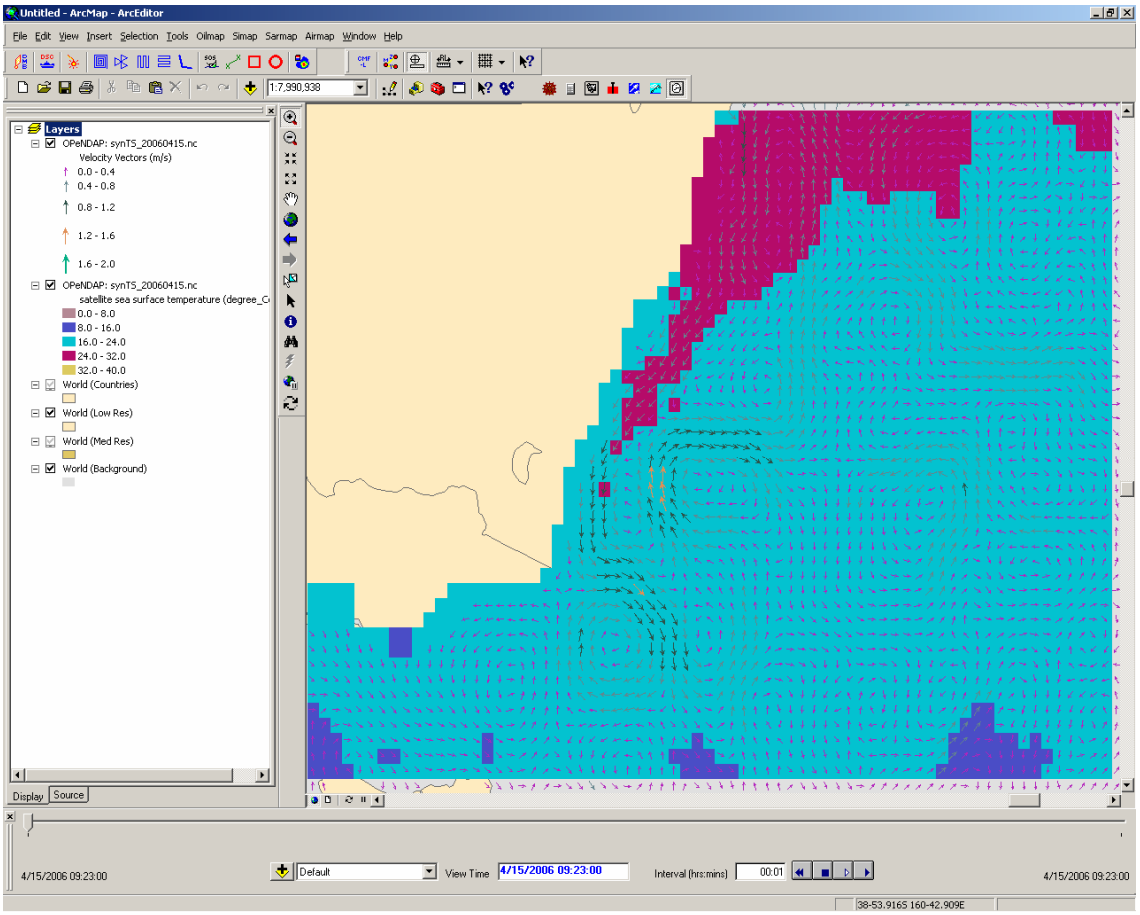

Untitled - ArcMap - ArcEditor
File Edit View Insert Selection Tools Oilmap Simap Sarmap Airmap Window Help
1:18,191,350
Layers
OPeNDAP: hday
1.25 km SST (degree_C)
0.0 - 6.0
6.0 - 12.0
12.0 - 18.0
18.0 - 24.0
24.0 - 30.0
World (Countries)
World (Low Res)
World (Med Res)
World (Background)
Display
Source
3/24/2006 19:02:00
Default
View Time
3/24/2006 21:02:00
Interval (hrs:mins)
01:00
4/4/2006 21:15:00
Zoom out on the center of your map
42-26.804N 131-11.143W

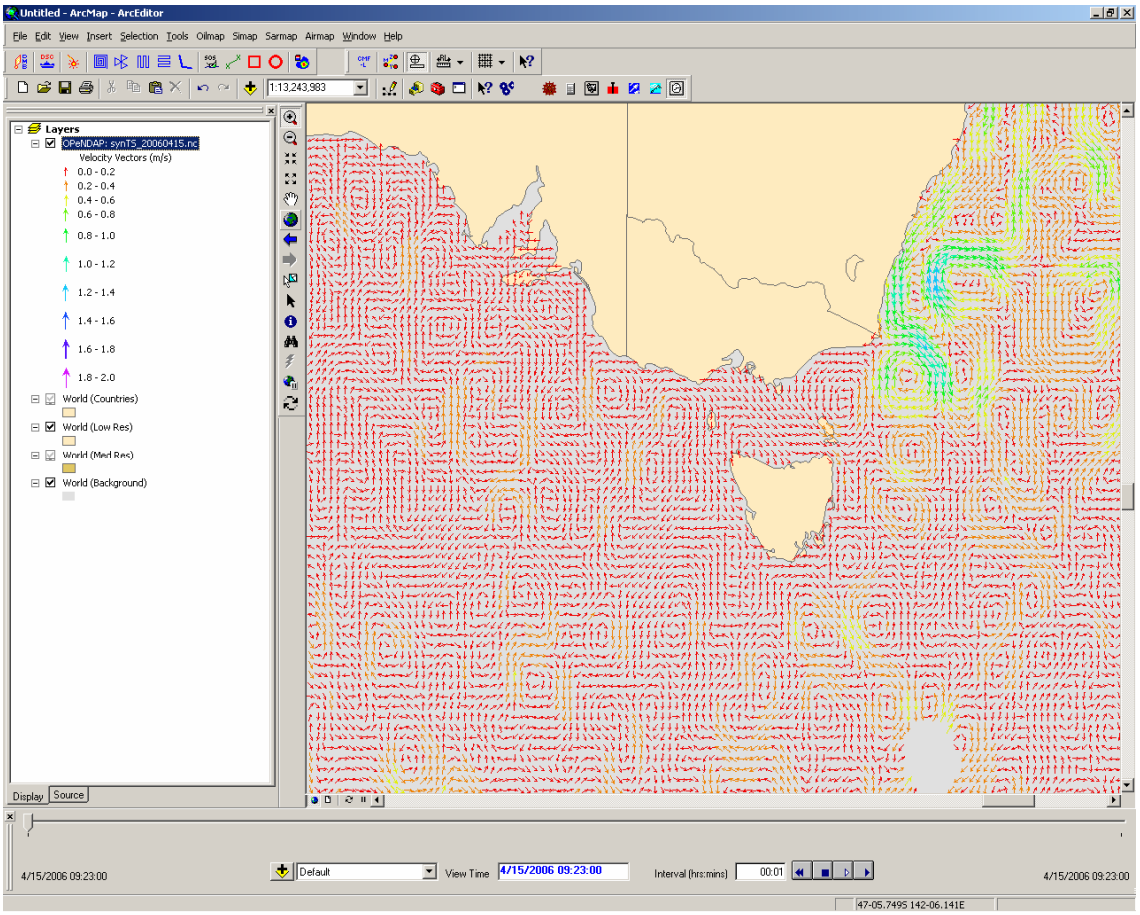

Untitled - ArcMap - ArcEditor
File Edit View Insert Selection Tools Oilmap Simap Sarmap Airmap Window Help
1:5,047,654
Layers
OPeNDAP: hday
1.25 km SST (degree_C)
0.0 - 6.0
6.0 - 12.0
12.0 - 18.0
18.0 - 24.0
24.0 - 30.0
World (Countries)
World (Low Res)
World (Med Res)
World (Background)
Display
Source
3/24/2006 19:02:00
Default
View Time
3/24/2006 21:02:00
Interval (hrs:mins)
01:00
4/4/2006 21:15:00
26-49.847N 117-44.798W

http://www.marine.csiro.au/dods/nph-dods/dods-data/bluelink/synTS/synTS_20060415.nc






Untitled - ArcMap - ArcEditor
File Edit View Insert Selection Tools Oilmap Simap Sarmap Airmap Window Help
1:7,990,938
Layers
OPeNDAP: synTS_20060415.nc
Velocity Vectors (m/s)
0.0 - 0.4
0.4 - 0.8
0.8 - 1.2
1.2 - 1.6
1.6 - 2.0
OPeNDAP: synTS_20060415.nc
satellite sea surface temperature (degree_C
0.0 - 8.0
8.0 - 16.0
16.0 - 24.0
24.0 - 32.0
32.0 - 40.0
World (Countries)
World (Low Res)
World (Med Res)
World (Background)
Display
Source
4/15/2006 09:23:00
Default
View Time
4/15/2006 09:23:00
Interval (hrs:mins)
00:01
4/15/2006 09:23:00
38-53.9165 160-42.909E


Untitled - ArcMap - ArcEditor
File Edit View Insert Selection Tools Oilmap Simap Sarmap Airmap Window Help
1:13,243,983
Layers
OPeNDAP: synTS_20060415.nc
Velocity Vectors (m/s)
0.0 - 0.2
0.2 - 0.4
0.4 - 0.6
0.6 - 0.8
0.8 - 1.0
1.0 - 1.2
1.2 - 1.4
1.4 - 1.6
1.6 - 1.8
1.8 - 2.0
World (Countries)
World (Low Res)
World (Med Res)
World (Background)
Display
Source
4/15/2006 09:23:00
Default
View Time
4/15/2006 09:23:00
Interval (hrs:mins)
00:01
4/15/2006 09:23:00
47-05.749S 142-06.141E